LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The editor will be glad to publish any queries consonant with the character of the journal.

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

The Flight of Birds.

ONE would suppose that there could be little difference of opinion in regard to such fundamental principles of avian flight as the direction in which the down-stroke of the wings is delivered, and the relative positions to a horizontal plane of the anterior and posterior margins of the wings during this and the up-stroke. Nevertheless the other day I was completely astounded at some ideas expressed in "Animal Locomotion; or, Walking, Swimming, and Flying," by G. Bell Pettigrew, M.D., F.R.S., F.R.S.E., F.R.C.P.E., and connected with several other scientific and educational institutions (International Scientific Series, 1888).

Never having happened to see any review or remarks upon this remarkable work, I am in ignorance of how it has been received by the scientific world. To me it appears so completely illogical in parts, that I cannot refrain from presenting these remarks; so that, if I be as completely mistaken as to me appears to be this author, some one may kindly put me aright, that my ignorance of some fundamental points of aerostatics and animal mechanism may not vitiate my further observations in this line. It is with considerable diffidence that I venture to advance my opinion against that of one who has spent some twenty years upon the subject, and who, judging by the position that he occupies, certainly should be capable of coming to satisfactory conclusions on the subject; but my utter inability, after considerable study of the matter, to admit the possibility of what is given as the main principle of avian flight, induces me to bring the matter forward.

I will put the case in the author's own words, here as elsewhere, with his Italics (p. 197): "*Reasons why the effective stroke should be delivered downwards and forwards.*— The wings of all birds, whatever their form, act by alternately presenting oblique and comparatively non-oblique surfaces to the air,— the mere extension of the pinion, as has been shown, causing the primary, secondary, and tertiary feathers to roll down till they make an angle of 30° or so with the horizon, in order to prepare it for giving the effective stroke, which is delivered with great rapidity and energy, in a *downward* and *forward* direction." My first impression was that such a movement would drive the bird upwards and backwards, and subsequent study of the subject only makes me the more positive of this. Theoretically I believe that any body suspended in a fluid medium will tend to move in a direction opposite to that in which the medium is forced by the members of that body. Take a wing of a bird and vibrate it rapidly, as its movements are described by Dr. Pettigrew, before the flame of a candle, and we shall find that the flame is driven downward and forward.

On p. 95 we are told, "In the water the wing, when most effective, strikes *downwards* and *backwards*, and acts as an auxiliary of the foot; whereas in the air it strikes *downwards* and *forwards*." I fail to see why a movement that produces locomotion in one direction in water should be reversed in the air to produce locomotion in the same direction; and my mystification is increased when I read on p. 108, "Flight may also be produced by a very oblique and almost horizontal stroke of the wing, as in some insects, e.g., the wasp, blue-bottle, and other flies," for here I am left in doubt whether opposite directions of applying the wing produce the same direction of locomotion, or whether I am to believe that an "almost horizontal stroke of the wing" forwards produces a forward movement of the body. For the present I am inclined to believe neither the one nor the other. Again, on p. 204, in the explanation of Fig. 107, we read, "The Red-headed Pochard (*Fuligula ferina*, Linn.) in the act of dropping upon the water; the head and body being inclined upwards and forwards, the feet expanded, and the wings delivering vigorous short strokes in a downward and forward direction.— *Original.*" The questions presented to my mind by this are these: "Does the duck really wish to increase its speed just before alighting upon the water, or does the fact of the strokes being 'vigorous short strokes' diametrically change their effect on the body from what would be produced by leisurely short strokes or vigorous long strokes?" I imagine that if the bird were in its right mind it would wish to check its course,— in other words, to give an upward and backward impulse to its body before coming in contact with the water, — and I should approve of its giving downward and forward strokes to its wings in order to accomplish this end.

Many other of Dr. Pettigrew's illustrations, both pictorial and verbal, also do violence to my ideas without convincing me: in fact, I seem to see exactly the opposite in them to what he has found. For instance: in Figs. 53 and 54, illustrating the action of the wing, the hinder edge of the wing must be below the anterior on the up-stroke and above it on the down-stroke, which is exactly the reverse of what he tells us occurs in flight. On pp. 156 and 157 we read, "It is a condition of natural wings; and of

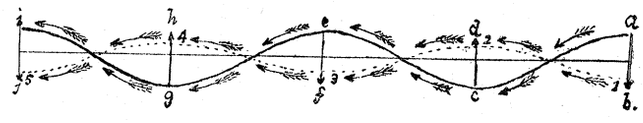

FIG. 1 (FIG. 81 IN ORIGINAL).

artificial wings constructed on the principle of living wings, that when forcibly elevated and depressed, even in a strictly vertical direction, they inevitably dart forward. This is well shown in Fig. 81. If, for example, the wing is suddenly depressed in *a vertical direction*, as represented at *a b*, it at once darts downwards and forwards in a curve to *c*, thus converting the vertical down-stroke into *a down oblique forward stroke*. If, again, the wing be suddenly elevated in a strictly vertical direction, as at *c d*, the wing as certainly darts upwards and forwards in a curve to *e*, thus converting the vertical up-stroke into an *upward oblique forward stroke*. The same thing happens when the wing is depressed from *e* to *f*, and elevated from *g* to *h*." Admitted. But the posterior margin of the wing must be elevated during this movement, or one of two things must take place. If this margin be depressed, the wing will move in a contrary direction; i.e., backwards and downwards. If this does not take place, then force must be used which will cause an appreciable upward and

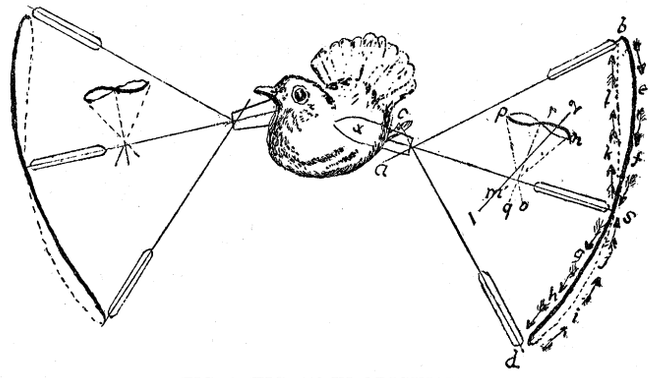

FIG. 2 (FIG. 116 IN ORIGINAL).

backward recoil to the hand moving the wing. In the same way the posterior margin of the wing will be lower than the anterior instead of above it, as the author states, during the upward stroke of the wing. Also I had imagined that the buoyancy and progression of a bird depended on the resistance that the wing encountered. If it be allowed to move in the plane of least resistance, it will move forward while the body remains stationary; whereas if not allowed to move forward, or forced slightly backward, then, and only then, can a forward impulse be given to the body. I might cite my personal observations of the movements of the wings of flying birds against the observations of Dr. Pettigrew; but in that case he would have in his favor the longer length of time during which his observations have taken place.

To draw the discussion to a close, which, if I am in the wrong, has sufficiently exposed my ignorance, I will call attention to Fig. 116. On p. 231 we read, "Instead of the two wings forming one

cone, the base of which is directed *forwards*, each wing of itself forms two cones, the bases of which are directed *backwards* and outwards, as shown at Fig. 116. In this figure the action of the wing is compared to the sculling of an oar, to which it bears considerable resemblance.[1] The one cone, viz., that with its base directed outwards, is represented at *x b d*. This cone corresponds to the area mapped out by the tip of the wing in the process of *elevating*. The second cone, viz., that with its base directed backwards, is represented at *q p n*. This cone corresponds to the area mapped out by the posterior margin of the wing in the process of *propelling*. The two cones are produced in virtue of the wing rotating on its root and along its anterior margins as it ascends and descends (Fig. 80, p. 149; Fig. 83, p. 158). The present figure (116) shows the double twisting action of the wing, the tip describing the figure of 8 indicated *a b c f g h d i j k l;* the posterior margins describing the figure of 8 indicated at *p r n*." We readily see that the cone *x b d* is formed by the downward or elevating stroke, the wing passing from *a b* to *x s* and *c d*. It is an elevating power both because of the direct lifting-power of the wing from *a b* to *x s*, and because of the action of the two wings on the wedge or cone of air formed by the line *c d* and its correspondent of the opposite side. In this case the wing is in each of its positions extended on the lines *a b*, *x s*, and *c d*. But I can't as readily explain the cone *q p n*. That this transverse section of the wing does not run parallel to the lines *o p*, *q r*, and *m n* if its edge be turned downward on the down-stroke and upward on the up-stroke, is evident. The down-stroke is the propelling one. Let us see how it produces the cone. I have added the line 1 2 to the figure to represent the position of a transverse section of the wing during its downward course. As we have been told that the primaries, secondaries, etc., roll down into this position upon the wing being extended, and as the wing is extended nearly at or upon the commencement of the down-stroke, we find that the plane of this section cuts the line *o p* at an angle of about 60°, the line *q r* at an angle of about 30°, and only becomes parallel to *m n*. Then here, as elsewhere, I have shown, we have very opposite causes producing the same effect. Now, let us see what really would be the result of this. We are told that the wing works upon compressed air, that "it produces a whirlwind of its own upon which it acts," etc. Let *q p n* represent, then, the cone of compressed air. The wing 1 2, cutting into this cone at the angle which it does, will of necessity be forced backwards towards the base *p r n*, instead of gliding along *o p*, as it would were its posterior margins elevated so that its plane lay in the direction *o p*. The same state of affairs, only reversed, would take place during the upward stroke of the wing.

In this discussion I have considered the wing as having a flat surface. That it is somewhat screw-shaped, i.e., twisted upon its axis, does not altar, so far as I can see, any of the principles here involved. It appears to me that during all of the discussion of flight Dr. Pettigrew has entirely failed to distinguish the difference between an active and a passive organ. In the inclination of the wings he has reasoned as though the air was acting on the wings instead of the opposite state of affairs, which occurs in active flight, where the wings act upon the air.

There are numerous other points in aerial, aqueous, and terrestrial locomotion where I cannot help thinking that our author has erred; but, as none of them involve such fundamental principles as have here been discussed, I will not now allude to them.

HENRY L. WARD.

Tacubaya, D. F., Mex., Dec. 30, 1890.

The American Idea of Architecture.

THE statement in a recent issue of the *Record and Guide*, that the dominant conditions of American architecture "are not those that make for the greatest beauty, or for the highest health, or for charm, but for the largest return in cash," is a most alarming indication of the estimation in which architecture is held in this country. Coming from so eminent a source, it carries additional weight, and shows very clearly that even those who by profession are nominally responsible for all that is great or good, poor or indifferent, in the important art of architecture, have given up hope of elevating it to the broader platform which it occupied in past times; and surely, if the doctors have admitted the patient incurable, it is obviously unwise for an outsider to maintain the contrary.

This utterance of the *Record and Guide* is an admission from exalted quarters that in architecture all considerations must be sunk save those of dollars and cents. It shows, what indeed may be gathered any day in a brief walk through almost any street of our chief cities, that the idea of art quality, of utility, of the natural effects of the environment, and many similar causes whose influence is to be traced in all the good architecture of previous periods, are quite wanting in the art of the present day and generation. It is an indication of indifference to every thing but cost, of measuring art values and art qualities by the price per square inch, or, which is much the same thing, by the revenue per square foot,— most necessary to keep in mind, but altogether improper in judging of architectural merits. The point to be remembered is not the falseness of this criterion, not its absurdity, but the candid admission by an undisputed authority that it is the cardinal principle in American architecture, and that it is useless to contend against it. And, indeed, it might well be so; for if this idea has become firmly rooted in the minds of those who are concerned with architecture, who are erecting buildings as well as designing them, it is impossible to look for any better results than we have already obtained.

There is not only a popular misconception that architecture is a matter of cost, but also that it is concerned chiefly with the exteriors of buildings, and is not a science of plan, convenience, use, and similar influences. It is not the least surprising that a people who view their architecture through the medium of price should believe that the whole of it should be visible to the world at large in the exterior of their structures. That the American public is prone to judge of architecture by external æsthetic qualities is quite evident from the recent exhibition of the Architectural League in New York. This body is composed of the leading architects in the city, and its work is naturally the product of the best architectural culture in the country. Its annual exhibitions are looked upon by that section of the public interested in the serious treatment of architectural ideas as authoritative indications of whatever progress may have been made in American architecture during each year. Certainly the *personnel* of this society, and the names of those who send their work to its exhibitions, are sufficient justification for the estimation in which it is held. The exhibition that has just closed cannot be viewed as at all satisfactory to the public it was designed to instruct; and this, not because the work shown was of an inferior quality, not because it was lacking in firm, intelligent treatment, or was deficient in ideas, but because the drawings consisted solely of exteriors and picturesque effects.

It is not in the least critical of the work shown, to remark, that, in confining itself to these aspects of architecture, this important body of American architects has given its formal sanction to the idea that if a building looks well, all has been done that is needful to make it good architecture. On no other grounds does it appear possible to explain the predominance of exteriors in this collection. It is to be admitted that the artistic treatment of exteriors is one of the most important problems the architect has to deal with; but it is only one, and architecture has to do with many. It is not unreasonable to insist that it is quite as important to cover a given area well as to erect a façade that extends upwards into space for any desired distance. There is, however, a widely extended opinion that architecture is a matter of outsides, and is not at all of what is within. The outlook for American architecture is, in truth, discouraging when such a view receives the official support of an eminent body of architects.

It is not to be supposed that so advanced a journal as the *Record and Guide* should be backward in presenting the same idea. In a late issue it gave a review of the work done on the west side of New York, the seat of the most active building operations in the metropolis, in which, out of sixty-four illustrations, forty-nine were of exteriors, twelve bits of interiors, and three plans. It

[1] "In sculling, strictly speaking, it is the upper surface of the oar which is most effective, whereas in flying it is the under."